Evaluation of the South Carolina Department of Transportation 2007 Supplemental Specification on Critical Path Method Construction Schedules

A Certified Public Manager Research Project

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"Critical Path Method, CPM - A charting of all events and operations to be encountered in completing a given process. The method is rendered in a form permitting determination of the relative significance of each event, and establishing the optimum sequence and duration of operations." (Means Illustrated Construction Dictionary, 1985, p. 125)

Department of Transportation Construction Scheduling History

There have been several forms of scheduling requirements over the years at the South Carolina Department of Transportation. Construction projects let under the 1964 South Carolina State Highway Department Standard Specification for Highway Construction addressed the contractor's failure to maintain satisfactory progress.

> "The Contractor shall be declared delinquent in his work and will be disqualified for further bidding and for approval as a subcontractor if at any time both (1) the actual percentage of work completed for any contract is not within a reasonable percentage of the dollar volume which should have been performed using the Contractor's own approved work schedule, and (2) the percentage of the value of the contract completed is not within a reasonable percentage of the contract time expired" (South Carolina State Highway Department Standard Specifications for Highway Construction - Edition 1964, p. 45).

In the revised 1973 standard specifications, a contractor's progress schedule was required to be submitted within 10 days after the contract was awarded.

> "...the Contractor shall submit to the Department a progress schedule for the project which will show in detail that all work covered by the contract and including the acceptance of the entire project will be completed within the prescribed working time. The progress schedule may be in the form of a graph with the progress curve having dollar volumes of work shown on the graph as percentages of the value of the entire contract plotted horizontally.....the graph will indicate readily a variation of 5 percent in actual progress from the scheduled progress" (South Carolina State Highway Department Standard Specifications for Highway Construction - Edition of 1973, pp. 57-58).

When the 1986 edition of standard specification was developed the specifications were revised and there was no emphasis on referencing the Contractor's own approved work schedule (South Carolina State Highway Department Standard Specifications for Highway Construction - Edition of 1986, p. 67).

Up to 1999, the SCDOT evaluated construction contract progress on a straight-line basis. A uniform payout line was assumed for the total contract duration, and the budget for construction payments was based upon this on all contracts statewide. An actual project status curve was tracked by comparing percent money expended to percent of contract time elapsed. By comparing the "theoretical straight-line" to the "actual project status curve" lines you could see how construction progress tracked.

During the period of 1999 to 2007, the department monitored the construction progress and the acceptable standard for deviation decreased from 25% to 10% of the contract total. In 2005, the SCDOT began requiring contractor's schedules again (over $5 Million CPM, under $5 Million Excel Spreadsheet) (Leigh Pennington, January 2007, pp. 3-4).

In March of 2007 the Critical Path Method schedule specification was developed and CPM schedules were required on all construction projects except very small limited scope projects (Appendix A). Additional on-call and limited scope projects were included in the exemption when a Non-CPM schedule supplemental specification came out in June of 2007 (Appendix B).

Cost to Provide CPM Construction Schedules:

There are several components when determining the cost of CPM construction schedules. The initial expense is the bid price for the contractor which includes an initial baseline schedule, monthly updates, and a final as-build project schedule. According to construction cash prediction research being conducted by the Director of Construction Office, based on 1,618 contracts that include the CPM bid item, the average contract unit price for a CPM schedule is $3,977. Of these contracts, 95% fall in the range of $0 to $12,000 per project. This $6.4 Million in total schedule cost is approximately 0.17% of the total construction bid cost for the same projects (Gambill, 2013).

Another component is the cost to the SCDOT to evaluate all of the baseline and monthly update schedules submitted for each construction project. Approximately $560,000 in salaries is paid out each year for seven District CPM Schedulers and the State Construction Scheduling Engineer to evaluate and analyze the information provided (State, 2012).

In addition, to ensure the schedules are being submitted accurately, the contractor's scheduler needs to communicate with his field personnel to ensure all revisions to the schedule are captured and reported to the SCDOT in their monthly updates. Also the SCDOT Resident Construction Engineer and their field personnel need to review the contractor's submittals for accuracy and communicate it to the District CPM Schedulers for their monthly update reply. The cost for the field personnel to review each project is variable depending on who is performing the review and the time spent on the review; therefore, it was not quantified in this review.

Benefit:

To help the District Construction Engineers and the Resident Construction Engineers in the counties it would be beneficial to compile all of the construction schedules together to see how many and what type of inspectors will be needed to cover construction project activity. This would help when deciding the workload of each Resident Construction Engineers office, and how to allocate both equipment and technical personnel during the year. This information would be beneficial to calculate future on-call consulting needs, as well as critical HR demands.

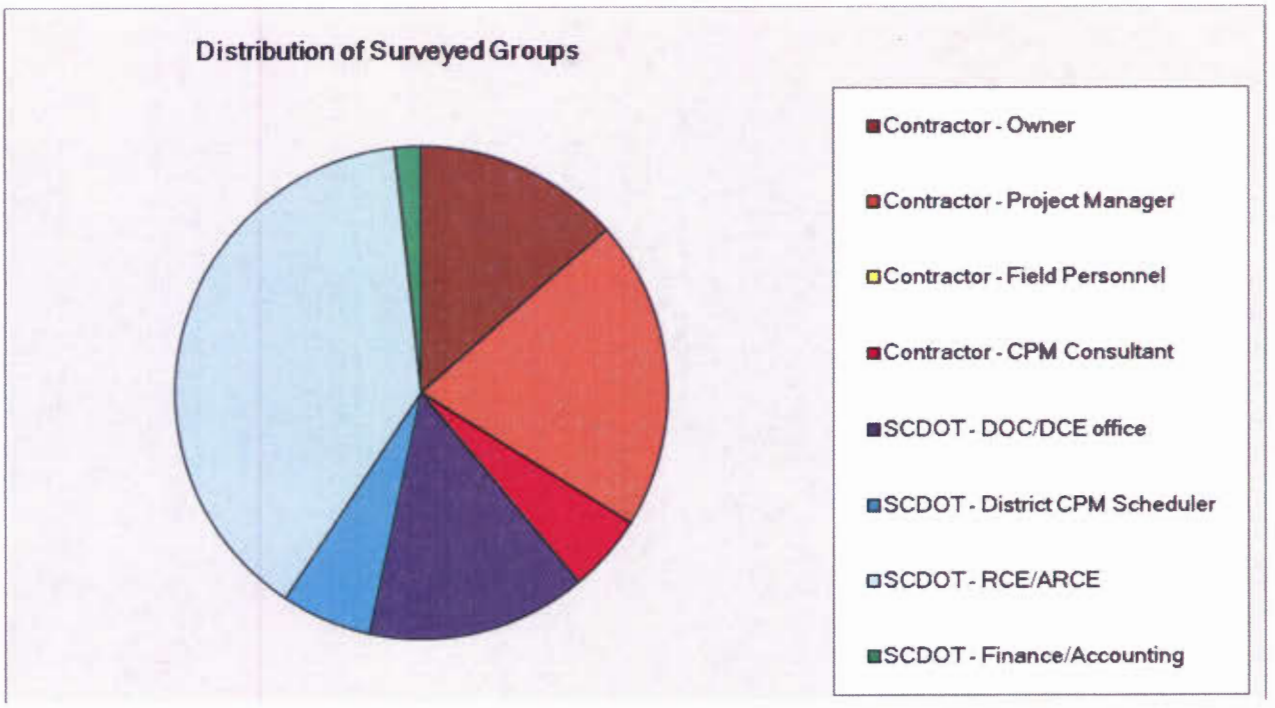
Contract status could be monitored monthly to indicate if there are problems that need to be addressed in the field, or hold the contractor accountable for field changes. This project documentation could be used by both the contractor and the SCDOT to justify time extensions for change order work. Also, the as-built schedules could be a valuable resource when resolving claims issues.

Ideally, if the department could compile all of the construction projects state wide then they would be able to track the majority of the monthly expenses to the department. If the SCDOT knew their monthly construction expenses they would not have to keep a $25 Million dollar cushion of funds in reserve and could put more money on the street by obligating more construction projects. Currently there is a need for short term and long term financial forecasting and schedules could allow the financial department to do so.

Survey Statistics:

Five different surveys were compiled and included in this report in detail in the appendix to help gain an understanding of the perspective of each group surveyed. The surveyed groups were the SCDOT Director of Construction / District Construction Engineers (Appendix C), SCDOT Resident Construction Engineers (Appendix D), SCDOT District CPM Schedulers (Appendix E), SCDOT Finance Office (Appendix F), and Contractor / Consultant CPM Schedulers (Appendix G). Survey Software (SurveyMonkey, 2012) was utilized online to gather and analyze the data from the anonymous surveys.

Overall Surveyed Groups	Response Percent	Response Count
Contractor - Owner	13.6%	16
Contractor - Project Manager	20.3%	24
Contractor - Field Personnel	0.0%	0
Contractor - CPM Consultant	5.1%	6
SCDOT - DOC/DCE office	14.4%	17
SCDOT - District CPM Scheduler	5.9%	7
SCDOT - Resident Construction Engineer	39.0%	46
SCDOT - Finance/Accounting	1.7%	2
	answered question	118



All SCDOT personnel were contacted via email and a response was received from 100% of the groups surveyed including all seven engineering districts and Resident Construction Engineering county offices. An email was sent to the entire list of heavy highway contractors who work in South Carolina that had a valid contact email address on the American General Contractors member on-line directory. A response was received from 40 of the 140 contacted (29.6%), and 100% of the six CPM consultant contractors contacted.

Findings:

2007 CPM Supplemental Specification Goal - Overview:

The contracting community requested a scheduling specification revision because they felt it was not reasonable to monitoring construction progress based on the "theoretical straight-line" schedule and only allow a 10% deviation. A goal when developing the SCDOT 2007 CPM Scheduling specification "was to provide a fairer method of evaluating the contractor's construction progress, manage construction payment forecasting, and scheduling of engineering and inspection personnel" (Leigh Pennington, January 2007). The

following section is a highlight of applicable survey data that addresses each goal called out during the supplemental specification development process.

Goal - Managing Construction Project Progress:

- 66.7% of contractors use CPM schedules to justify/quantify time for time extensions on change orders.
- 65.2% of RCE's use the CPM schedules to justify/quantify time for time extensions on change orders.
- 69.7% of contractors feel that without a CPM schedule they could only determine a change is necessary to meet a deadline two months out or less.
- 66.6% of RCE/ARCE's feel that without a CPM schedule they could only determine a change is necessary to meet a deadline two months out or less.
- Construction monthly progress estimates are not paid out for the same period each month.
    - Progress estimates are generated for work ending of the last day of each month in Engineering District 2, 3 and 5 (SCDOT, 2007, p. 79).
    - Progress estimates are generated for work ending the 16th day of each month in Engineering District 1, 4, 6, and 7. (SCDOT, 2007, p. 79)
- 81.8% of contractors feel it would not be a problem to have a uniform due date statewide.
- 98.6% of SCDOT employee's feel it would not be a problem to have a uniform due date statewide.

Goal – Managing Construction Payout for Financial Forecasting:

- 54.5% of contractors feel that the CPM schedules are not accurate to forecast 3 months out or greater.
- 81.25% of DOC/DCE engineers feel that the CPM schedules are not accurate beyond 2 months out.
- 92.8% of RCE/ARCE's feel that the CPM schedules are not accurate beyond 2 months out.
- 42.9% of District CPM Schedulers feel that the CPM schedules are not accurate beyond 1 month out.
- 50% of SCDOT finance department surveyed report that the construction monthly estimate data is not meeting their expectation for accuracy 1 month out, 3 months out, or their long term forecast.
- SCDOT finance department feels that an acceptable range of deviation from scheduled monthly construction estimate payout for 6 month out is less than 20%.
- 100% of SCDOT finance department surveyed report that the construction monthly estimate data is not meeting their expectation for accuracy 6 months out.
- SCDOT finance department uses construction monthly estimates 12 to 24 months out for financial forecasting.

Goal – Managing Construction Field Personnel:

- 0% of contractors forwarded this survey to their field personnel.
- 29.6% of contractors contacted responded to this survey.
- 72.7% of contractors do not believe the CPM schedules are a benefit for their field personnel.
- 53.1% of contractors feel that a 4-week schedule is more beneficial than a CPM schedule.
- 75.8% of contractors do not use CPM schedules to forecast man hours & monthly costs.
- 67.7% of contractors feel that the majority of contractors do not follow CPM schedule in the field.
- 36.3% of contractors view CPM schedules as minimal value to the contractor or something to meet a contract obligation.
- 2 contractors surveyed indicated that they use a different schedule in the field compared to what they submit for the CPM.
- 93.3% of RCE's feel that the majority of contractors do not follow their CPM schedule in the field.
- 90.2% of RCE's do not feel a CPM is a benefit to the contractor's field personnel.
- 62.8% of RCE's feel that a 4-week schedule is more beneficial than a CPM schedule.

Considerations:

There is an overall agreement amongst the surveyed groups, that a tool like CPM schedules can be used to manage risk and has value to them. However, the level of uncertainty that they are comfortable with is variable. Meeting the level of detail and accuracy to generate a 6 to 12 month financial forecast statewide with less than a 20% variance is one thing, but something different if looking for a schedule to plan construction activity for the upcoming week. The department should consider the application and the acceptable level of uncertainty for the end user of the data when selecting the appropriate risk management tool.

(Level of Risk Paired to the Level of Detail Schedules)

Other State DOT's like Virginia DOT have seen the benefits in pairing the level of detail schedules with the level of complexity and risk. VDOT has broken construction projects into 6 levels of complexity and risk

(Very Low, Low, Low-Med, Medium, High, and Very High) and have broken down the scheduling requirement for each (basic progress earning schedule with sequencing narrative, tabular schedule, time-scaled bar-chart schedule, value loaded CPM schedule, resource loaded CPM schedule, and qualified/dedicated project scheduler/coordinator with CPM and 4-week look-ahead schedules) (VDOT, 2008, pp. 13-21).

(SCDOT Perform Updates and as Built Schedules)

If the department would reduce the number of full CPM specified projects to the most complex/high risk ones it would cut back on the number of projects for the district schedule to monitor/review each month. If the District CPM Schedulers could focus their attention on the top six to eight high risk projects in each district they could maintain an intimate knowledge of these projects and help the Resident Engineers office manage risk and offer scheduling options by trouble shooting the contractors planned schedule, documenting as-built schedules, evaluating time change orders, and attending construction project meetings. Reportedly, then some of the District Schedulers could focus their time more on scheduling project issues and less on specification enforcement. There is also a need to educate the RCE's personnel more on basic scheduling so they can communicate more effectively and understand risk management. If there was more basic training at the Resident Engineers office, those employees at the project management level could track and input as built scheduling data on less complex projects, manage project risk at the local level and stay proficient in basic CPM scheduling and terminology.

(4-week Schedules Updated Every 2-week)

A basic 4-week scheduled look ahead updated every 2-weeks should be included in all construction special provisions to help the Resident Engineers office schedule his/her field personnel. This special provision was the norm prior to the use of CPM schedules, but should be included on all projects even if a CPM schedule

is required. This type schedule is more useful for a short look ahead for both the department and the contractor's personnel.

(District Assigned level of Risk During Preliminary Design Field Review)

Up until around June of 2012, the choice was to include the CPM specification in every construction contract unless it met the "non-CPM"schedule criteria. Currently, the decision to include the 2007 CPM scheduling specification or not is decided by the State Construction Scheduling Engineer with minimal project risk assessment based on project bid items and recommendations from the District CPM Scheduling Engineers. During a normal project development the preconstruction program managers meeting with district and county engineers to discuss preliminary plans, potential project issues (ROW, utility, drainage conflicts, local preferences) and make decisions on how to program the project and develop the construction contract. If the District Engineers could make a risk assessment of the project at this time the decision on what level of scheduling requirement is needed on the project would be based on better information.

(Uniform Estimate Date Statewide)

Prior to the implementation of SiteManager© and SCEIS© software, it was not practical to have a universal estimate date, but today the department could move to a universal estimate date without a burden on anyone. Currently, half of the SCDOT engineering districts were reporting two weeks behind the rest of the engineering districts and depending on when data was compiled for the financial department it could be almost a month behind. An easy first step to eliminate some variability in financial reporting would be to move to a universal estimate date and consistent data reporting date each month so that a more accurate presentation of data could be made, and trends could be analyzed.

(Historical Based Cash Flow Curves)

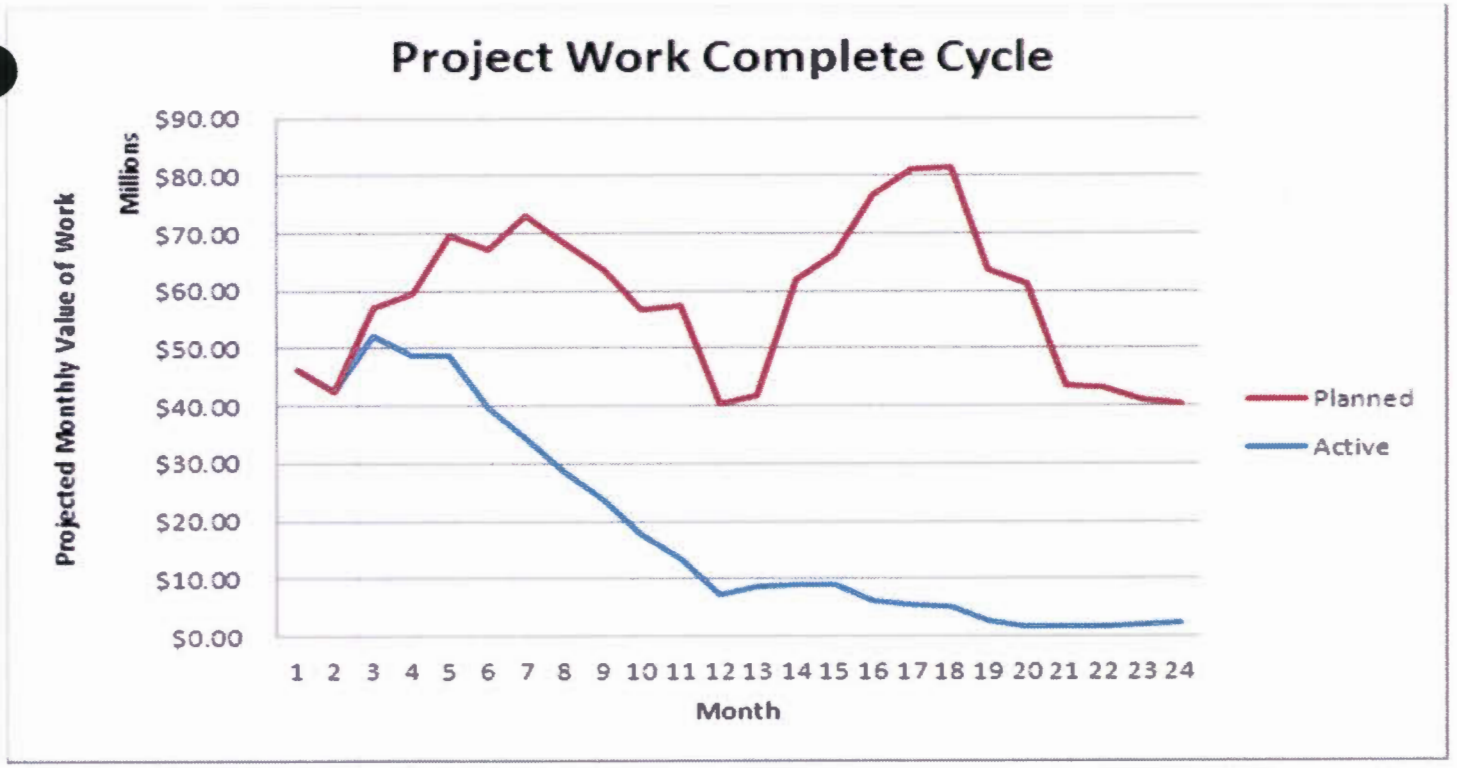
The department could reasonably develop construction cash flow curves for moderately and less complex projects based on historical data for multiple CPM project types. If there were 10 different project types considered it would address the bulk of typical construction projects. Possible project types include; single span bridge replacement, multiple span bridge replacement, secondary route resurfacing, multilane resurfacing, interstate resurfacing, two lane road widening, multilane road widening with drainage, intersection improvement, on-call maintenance items or other projects which last only one construction season and were less than $10 Million dollars. These historical curves would be more accurate when projecting planned preconstruction cash curves than the current straight line method and would be beneficial to have to monitor seasonal cash flow trends.

(Issue of Consumption of Construction Funds)

Based on the answers to the survey from the Financial Department there appears to be two groups focused on different ranges of financial forecasting interest. One group is concerned with, (very short term) "will there be enough money in the bank account to pay our bills this week" and another group who is looking out into the future 12-18 months (long term) to see if we will have enough funds during the life of the proposed planned projects for the construction season.

For the long term planners, the following graph is an approximation of how the preconstruction data (planned) has a bigger influence on financial forecasting than (active) current projects when finances are considered beyond seven months out. In addition, if you are using historical cash flow curves for all projects less than one year duration, the graph shows how insignificant the remaining active CPM scheduled projects have on the total planned value of work remaining and long term financial forecasting greater than nine

months out should be performed almost solely on preconstruction data (planned).



It is not as crucial for the active construction estimates to be tracking with their baseline CPM schedule beyond nine months out if the finance department is looking twelve months out or further. A large portion of construction funds are exhausted eight to nine months out. It is far more important to focus on what projects are being funded and scheduled in the preconstruction phase, as well as having a quality engineers estimate and project duration to project future cash flow.

(User Confidence and Buy-In)

Overall there is a lack of confidence in using the current CPM schedules across all the surveyed groups. If the contractors field personnel do not use or follow what their owners/office personnel present as their plan of action there is minimal value in using their data for forecasting. The Resident Engineers personnel are being asked to ensure that the contractor's schedules are accurate even though the contractor's field personnel change plans daily. District CPM Schedulers are spending their time inputting "straight-line" non-CPM

schedules and evaluating medium to moderately complex CPM schedules when project type specific curves can be developed to forecast cash payouts. Reportedly, some of the District Schedulers have minimal time to function as time risk managers for the district due to the volume of CPM's associated with the current specification, and are perceived by some contractors as simply specification enforcement. The department should not specify a high level of detail for items and milestones that are not high risk to the project or to the department. Historical project type based cash curves can provide the data needed for long term financial planning.

The CPM schedules can be misused as a micromanaging tool instead of a project communication tool. Some contractors feel that the department expends more efforts managing the scheduling software instead of the construction project and personnel. Further, Several contractors indicated that they are reluctant to provide too much information to the department in fear that it will be used against them and actually submit one schedule for the department to review and another to manage with. On projects with only moderate risk, (which could be defined as projects under $10 Million, short construction duration of one construction season, minimal subcontractors, minimal utility conflicts, or moderate level of complexity) the department should consider other less costly and time consuming management tools which would focus more on the importance to finish on time and less on the weekly/monthly deviation from a contractors baseline schedule. This is especially true since in most cases the contractor will still get paid for the work completed, but the payment is just delayed to the end, we are just penalizing them because the project did not track as close to the schedule as the department hoped it would track.

Summary:

Critical Path Schedules are just one tool that should be considered when managing risk. As stated previously, all the surveyed groups feel that there is a value to CPM schedules; however, most groups agree that it is being utilized more often than is necessary. The department needs to limit its requirement of CPM

schedules to high risk projects only in order to focus efforts and resources on the appropriate risk. If the level of risk is defined in the district during the design field review phase, then there is ample time to specify the appropriate level of schedule to manage the construction project. The level of confidence and acceptance of a project with a full CPM schedule should improve if a risk assessment warranted its use and it was limited to only a maximum risk project needing this management tool.

Most construction projects benefit by seeing an overall "base-line" schedule, so everyone involved with the project could see the general sequencing plan. However, the weekly planning of inspectors and resources is best done by referring to a 4-week schedule updated every two weeks. All projects would benefit by including these weekly schedules even if the CPM schedule is specified. In many cases this simple schedule might be all that is needed. Further, if the department could perform as-built schedules in house as the project progressed; we could include this with our project documentation which could be useful if there were any disputes or claims.

The Director of Construction office has already identified a need to establish a uniform estimate date and beginning at the end of January 2013 all engineering district will report on the same date state wide. In addition, a preliminary review of the historical cash curves being developed by the Director of Construction's office looks very promising for future applications.

CPM schedules are useful for financial forecasting, as long as the level of uncertainty is acceptable and understood by those using the data. By utilizing "level of risk versus level of scheduling" detail we can pair up the appropriate risk management tool to manage the appropriate level of risk. If additional historical cash curves could be developed that were specific to a project type it could further improve the accuracy for short and long term cash flow predictions. By utilizing more historical cash flow curves the department would not have to wait on the monthly estimate reporting cycle to forecast and could complete a data run daily if needed to track our cash flow. These historical curves could also function as a "place holder" until actual

monthly CPM updates are received on the high risk projects, and could be utilized when calculating contract completion dates prior to the construction letting.

CPM schedules are a proven risk management tool and have shown to be a beneficial communication tool as well. If the department would pair the level of scheduling to the level of risk it would convey the level of concern and attention desired to meet the department's level of concern.

Appendix A

CRITICAL PATH METHOD CONSTRUCTION SCHEDULES (March 1, 2007)

General

This supplemental specification addresses the Critical Path Method (CPM) construction schedule requirements for SCDOT contracts. The Contractor will provide and update a construction schedule to the SCDOT, which will be used as a quantitative basis for:

- Monitoring and evaluating the Contractor's progress in completing contracted work;
- Evaluating requests for additional contract time;
- Budgeting for construction estimate payments; and
- Managing SCDOT engineering and inspection personnel.

The Contractor's construction schedule shall encompass the entire contract period, and be developed consistent with the contract milestones and the contract maintenance of traffic plan. Critical path activities shall be identified for the duration of the work.

The schedule shall reflect the utility relocations noted in the contract documents and include activities of appropriate duration for the utility adjustments. Where utility durations are unknown, the Contractor shall provide a reasonable estimate of duration. Utility durations will be reviewed in the baseline approval process as outlined in the section "Submission, Review, and Acceptance Process." Utility durations will be presented at the Preconstruction Conference for concurrence by the utility provider. In the event that the utility representative cannot provide concurrence at the Preconstruction Conference, the Contractor, the Resident Construction Engineer, and the utility provider shall work diligently to reach acceptable durations. If there is no concurrence or input from the utility provider concerning the Contractor's utility durations within 15 days following the Preconstruction Conference, the submission with the Contractor's estimate of utility duration will be reviewed for baseline acceptance. Further utility duration changes beyond this point in time will be assessed in monthly schedule updates. Failure to include activities for any element of work or any known utility work will not relieve the Contractor from completing the work within the allotted contract time.

The schedule shall also include sufficient information *as outlined in this supplemental specification* to provide for monetary and quantitative tracking of the work by the SCDOT.

Schedule Types

Contractors shall maintain CPM schedules for all projects using Primavera 5.0 (or current version) or Primavera Contractor.

Templates for the CPM schedules are available to download at the SCDOT construction Extranet site (http://www.scdot.org/doing/const_extranet.shtml).

When submitting schedules to the SCDOT, the Contractor shall assign file names to each schedule file (baseline and updates) according to the following conventions (dates are YYMMDD):

Note on Data Dates -The initial Baseline Construction Schedule shall have a data date equal to the date of submission of the schedule and not include any work to date. Monthly schedule updates shall have a data date set the same as the most recent estimate period end date.

Type of Schedule Submitted:	Baseline	Update
File Name Convention:	[File Number]b[Data Date]	[File Number]u[Data Date]
File Name Example:	32.82571b060201	32.82571u060201

All submissions shall be made within the time frames defined under "Submission, Review and Acceptance Process."

Electronic File: Each baseline construction schedule and monthly update submission shall be uploaded to the SCDOT Construction Extranet site in .xer format. The site can be found at: (http://www.scdot.org/doing/const_extranet.shtml)

Hard Copies: A hard copy of each baseline construction schedule and monthly update submission shall be provided to the District Scheduler and the Resident Construction Engineer. Printout shall include the following columns on 11 inch x 17 inch paper: Activity ID, Activity Name, Early Start, Actual Start, Early Finish, Actual Finish, Schedule % Complete, Physical % Complete, Budgeted Total Cost, Actual Total Cost, Original Duration, Remaining Duration, and Total Float.

Schedule Narrative: Submit a Schedule Narrative Report with the baseline and each monthly update schedule describing current project schedule status and identifying potential delays. This report will include a description of the progress made since the previous schedule submission and objectives for the upcoming 30 calendar days.

1) The report shall indicate if the project is *on schedule*, *ahead of schedule* or *behind schedule* as compared to the accepted baseline. If the project is ahead of schedule or behind schedule, the report shall include the specific number of calendar days. If the project is behind schedule, the report shall include a detailed recovery plan that will put the project back on schedule.
2) The report will describe the *current critical path* of the project including the lowest total float value and indicate if this has changed in the last 30 calendar days. Discuss current successes or problems that have affected either the critical path's length or have caused a shift in the critical path within the last 30 calendar days. Identify specific activities, progress, or events that may reasonably be anticipated to impact the critical path within the next 30 calendar days, either to affect its length or to shift it to an alternate path.
3) List all schedule logic or duration changes that have been made to the schedule since the previous submission. Provide and explanation for any *constraint* used. For each change, describe the basis for the change and specifically identify the affected activities by identification number.
4) Identify activities, either in progress or scheduled to occur within the following 30 days, that require Department participation, review, approval, etc.
5) Identify any calendars used that are not DOT specific, and explain the details of those calendars.
6) Identify schedule settings used.
7) An explanation of lag for each activity lag is associated with.
8) Description of how the schedule is organized (e.g. broken down by road or activity).
9) Narrative will be submitted with a naming convention of [File Number]n[Data Date].doc (e.g 32.82571n060201.doc). Contractor will upload the *electronic copy* [in *.doc* format] to the South Carolina Department of Transportation Construction Extranet site (http://www.scdot.org/doing/const_extranet.shtml).

Schedule Details

Data Date -The Baseline Construction Schedule shall have a data date equal to the date of submission of the schedule and not include any completed work to date. Monthly schedule updates shall have a data date set the same as the most recent estimate period end date.

Milestones -Schedule shall identify the following milestones as a minimum:

- ***Notice to Proceed Date (NTP):*** Issuance of this date indicates the project site is available to the Contractor and contract time has begun. The NTP is determined in coordination between the Engineer and the Contractor and shall be within 45 days of the Award Date unless extenuating circumstances warrant setting the NTP more than 45 days after the Award Date. Include any extenuating circumstances in the narrative. The Notice to Proceed Date shall be the first milestone in the schedule.
- ***Work Begin Date:*** Actual date that on-site work commences.
- ***Interim Completion Dates or Interim Milestones:*** When interim completion dates or interim milestones (associated with project stages) are included in the contract specifications.
- ***Start of Paving:*** Date paving production and placement is to start.
- ***Substantial Work Complete Date:*** Anticipated date that work will be substantially complete. Facility will be available for the safe and convenient use of motorists; only allowable work remaining at substantial completion is placement of permanent pavement markings and resolution of punch list items.
- ***Contract Completion Date:*** Date defined by the Department as the latest date for contract completion. This is the last milestone and will establish the finish date of the project schedule. The schedule may indicate a completion date in advance of the contract completion date. However, the Department will not be liable for the Contractor's failure to complete the project prior to the Contract Completion Date. Any additional costs, including extended overhead incurred between the Contractor's schedule completion date and the completion of the contract time, shall be the responsibility of the Contractor.

Activities – Each Activity shall be part of the logic driven network and include a predecessor (excepting the first activity) and a successor (excepting the last activity). Each activity duration shall be limited to 30 days. As a minimum, the schedule shall include the following activities when related work is part of the contract, but there shall be sufficient detail in included activities to determine monthly progress of work and forecast of inspection and cost. The Contractor shall use the Activity Codes provided in the template for organizing activities. Activities for deliverables and reviews shall be included in the schedule.

- ***Mobilization:*** preparations for and moving of equipment, etc., to the project site.
- ***Clearing & Grubbing:*** Self-explanatory.
- ***Utility Relocations:*** The schedule must reflect the utility relocations noted in the contract documents and include activities of appropriate duration for the utility adjustments. Where utility durations are unknown, the Contractor shall provide a reasonable estimate of duration.
- ***Earthwork:*** Unclassified & borrow excavation, compaction, fine grading, etc.
- ***Drainage:*** Pipe, catch basins, manholes, etc.
- ***Base Course:*** Graded aggregate base courses, cement modified bases, etc.
- ***Paving:*** Hot mix asphalt base, intermediate, and surface courses; Portland cement concrete pavements, etc.
- ***Structures:*** Bridges, box culverts, retaining walls, etc.

The Department requires retained logic be used in scheduling projects. In situations where a Contractor has to address activities out of sequence, the Contractor may request to use the "progress override" option. The monthly schedule update narrative shall provide justification for selecting this option and quantify any logic change(s).

Resources – The Department will not require any input to the resource component of the schedule by the Contractor.

Expenses – Contractor shall assign the SCDOT contract items as expenses to each activity. SCDOT contract items will be included as Expense Categories and will be made part of the SCDOT schedule template

Calendars – Contractor shall assign an appropriate SCDOT calendar to each activity in the schedule. Alternate calendars may be assigned, but specifics of the alternate calendars must be justified in the baseline narrative. Contractor shall assign all calendars as project specific. Acceptance of the alternate calendars is subject to review by the SCDOT. Considerations for weather shall be addressed within the activities – calendars shall not be modified to account for weather considerations. Calendars have been created to address established seasonal restrictions.

The Baseline Construction Schedule shall not extend beyond the number of working days or contract completion date originally provided in the contract.

Cost Loading – All schedule activities shall be cost loaded using the contract items and unit prices under "Expenses" in Primavera.

Float – Float is not for the exclusive use or benefit of either the Department or the Contractor. Initial baseline schedules shall not attribute negative float or negative lag to any activity.

Schedule Layout – Schedule shall be structured consistent with the phasing and staging noted in the contract documents. Activity Codes for area and stage are included in the template. These codes shall be used to organize each activity included in "Schedule Details – Activities" as appropriate to provide a detailed schedule layout. Activities shall not be allowed to cover more than one stage of the contract.

Default Values – Contractor shall use the following defaults, physical percent complete, retain logic, and longest path critical activities.

Submission, Review and Acceptance Process

Baseline Schedule – Contractor shall submit a Critical Path Method (CPM) Contract Schedule and Narrative to the District Scheduler within 30 calendar days after award of the Contract or 15 days prior to the preconstruction conference, whichever is earlier. The CPM Schedule and Narrative shall be submitted via upload to the Extranet. Upon upload, the Contractor shall immediately notify the District Scheduler and the Resident Engineer via email that the CPM schedule has been submitted.

Upon receipt of the CPM Construction Schedule, SCDOT shall review and provide comments to the Contractor within 10 days of receipt. The Contractor will have 5 business days to respond to SCDOT comments. This process will continue until the Engineer and the District Scheduler determine the construction schedule is acceptable.

The Contractor shall present their accepted schedule at the Preconstruction Conference. In the event the schedule has not been accepted (i.e. review process is ongoing), the most current schedule under review shall be presented.

Acceptance of the submitted schedule by the SCDOT will establish the baseline schedule for the contract. This acceptance by SCDOT does not serve to excuse any omissions or errors in the Contractor's schedule (i.e. activities not included in baseline will not be considered in any time extensions).

Review and acceptance of baseline schedule is required prior to start of work. Delays in reaching this acceptance will not constitute a basis for granting additional contract time. If there is no concurrence or input from the utility provider concerning the Contractor's utility durations within 15 days following the Preconstruction Conference, the submission with the Contractor's estimate of utility duration will be reviewed

Monthly Updates – Monthly updates shall be made no later than 15 days following the most recent estimate and shall have a data date the same as the estimate period end date. Upon upload, the Contractor shall immediately notify the District Scheduler and the Resident Engineer via email that the CPM schedule has been submitted. Failure to submit acceptable schedule updates as required will result in the withholding of estimate payments. Updates shall include the following:

- Updated schedule to show actual progress on activities
- Updated schedule to show actual costs on activities
- Updated schedule to show actual completion on milestones
- Narrative to describe progress, planned activities, issues, adjustments to remedy any activities or milestones behind schedule, etc., in the format described in ***Schedule Submissions.***

As-Built Schedule – A final As-Built Schedule shall be submitted within 45 days following substantial completion of the work or within 15 days following the contract completion, whichever is later.

Baseline Schedule Changes – Once the baseline schedule has been accepted, all subsequent schedules provided will be considered schedule updates and compared to the original baseline. A new baseline will only be considered when significant changes in contract scope, changes in SCDOT priorities, or delays beyond the control of the Contractor occur.

If a baseline change is needed, the Contractor shall provide, in writing, a request to the Resident Construction Engineer with the following information:

- An electronic copy of the proposed baseline schedule using the following naming convention and in accordance with **Schedule Types** (included previously) Narrative identifying changes warranting a new baseline A decision for an updated baseline will be made jointly between the Resident Engineer and the District Scheduler within 10 days of receipt of request.

Measurement and Basis of Payment

The Department will make partial payments according to Section 109, Standard Specifications for Highway Construction, and as modified by the following schedule:

Basis of Payment	Percentage of Contract Unit Price of Item
After the Engineer has approved the CPM Baseline schedule	60
After the Engineer has approved the As-Built CPM schedule	40

The Department will pay for the accepted quantities at the contract price as follows:

1080300	CPM Progress Schedule

Appendix B

A CPM schedule is not required for projects consisting only of bid items of work related to any of the following:

traffic markings

traffic markers

signing without overhead structures

bridge painting

fencing

small quantity sidewalk repair, curb and gutter repair, catch basin repair, handicap ramps, or driveway repair.

crack sealing

guardrail

on-call maintenance items

For these types of projects, the verbiage below will be inserted in Section 108. Construction Schedule of the special provisions in lieu of the reference to the CPM specification.

No electronic CPM Schedule will be required for this contract. In lieu of the electronic CPM schedule, provide the following information to the RCE and District Scheduler prior to the Notice to Proceed Date:

- *Planned work start date*
- *Planned completion date*
- *Anticipated payments by estimate period*

The SCDOT will use this information to create a proxy CPM schedule in the department's database to account for the work and cash flow generated by this contract. Provide updates to this information in the event there is a significant change to the scope of work or an adjustment to the completion date. If contract progress falls behind, provide a recovery plan to the RCE and District Scheduler no later than 15 days following the estimate period end date where progress lapsed. No payment or separate pay item is included for the provision of this information. Include any costs to provide this information in other items of work.

Appendix C

SCDOT - Critical Path Scheduling Specification
(Director of Construction / District Construction Engineers)

What SCDOT district do you mostly work in?

Answer Options	Response Percent	Response Count
District 1	5.9%	1
District 2	5.9%	1
District 3	11.8%	2
District 4	5.9%	1
District 5	5.9%	1
District 6	11.8%	2
District 7	5.9%	1
Statewide	47.1%	8
	answered question	17

If we did not have a contractual requirement, what percentage of contractors do you feel would still perform a CPM schedule for their own benefit?

Answer Options	Response Percent	Response Count
None	5.9%	1
1 to 5%	11.8%	2
6 to 10%	29.4%	5
11 to 25%	47.1%	8
26 to 50%	5.9%	1
Greater than 50%	0.0%	0
	answered question	17

Do you enforce the CPM schedule specifications (withhold payments for no submission, discuss late submittals with contractor, preliminary delinquency)?

Answer Options	Response Percent	Response Count
Yes	100.0%	14
No	0.0%	0
	answered question	14

Do you feel the contractors CPM schedules are more beneficial than a traditional 4-week schedule updated every 2-week?

Answer Options	Response Percent	Response Count
Yes	43.8%	7
No	56.3%	9
	answered question	16

SCDOT - Critical Path Scheduling Specification
(Director of Construction / District Construction Engineers)

Do you feel that your time spent on the CPM baseline & monthly updates is a benefit to your office?

Answer Options	Response Percent	Response Count
Yes	87.5%	7
No	12.5%	1
	answered question	8

Do you feel that the current specification CPM schedule is a benefit to the finance department?

Answer Options	Response Percent	Response Count
Yes	66.7%	8
No	33.3%	4
	answered question	12

Do you feel that the current specification CPM schedule is a benefit to the RCE & field staff?

Answer Options	Response Percent	Response Count
Yes	73.3%	11
No	26.7%	4
	answered question	15

Do you feel that the current specification CPM schedule is a benefit to the contractor's field personnel?

Answer Options	Response Percent	Response Count
Yes	35.3%	6
No	64.7%	11
	answered question	17

Would a universal estimate date at the end of the month state-wide be a problem for you?

Answer Options	Response Percent	Response Count
Yes	0.0%	0
No	100.0%	16
	answered question	16

SCDOT - Critical Path Scheduling Specification
(Director of Construction / District Construction Engineers)

Without the use of a CPM schedule how far out do you feel that you can accurately determine something has to change (additional manpower, production, man hours worked, etc.) or the schedule will never recover?

Answer Options	Response Percent	Response Count
One month	12.5%	2
Two months	12.5%	2
Three months	18.8%	3
Four months	0.0%	0
Unknown	56.3%	9
	answered question	16

How far ahead do you feel that the monthly update CPM schedules are accurate enough to forecast monthly payout state wide?

Answer Options	Response Percent	Response Count
Not accurate to forecast at all	43.8%	7
1 month	25.0%	4
2 months	12.5%	2
3 months	18.8%	3
	answered question	16

How can we improve the accuracy of CPM schedules submitted by the contractor/consultant?

Answers

Change the update frequency to bi-monthly or quarterly.
Need contractor buy-in and then need to use them on project.
Level of schedule detail should be comparable to project complexity.
Minimize or prohibit changes to the baseline.
Hold contractors in delinquency until schedule recovers.
Require CPM schedules only on complex/high risk projects so more time to evaluate.

Make CPM schedules worth more (% of contract and reduce monies due for poor performance).
More attention and buy in of baseline by all parties.
Limit payout to contractor based on scheduled work.

Contractors should be evaluated based on scheduling ability on their contractor evaluation score.

SCDOT - Critical Path Scheduling Specification
(Director of Construction / District Construction Engineers)

What percentage of contractors do you feel actually follow their monthly schedules in the field?

Answer Options	Response Percent	Response Count
None 0%	6.3%	1
1 % to 10%	31.3%	5
10% to 25%	31.3%	5
26% to 50%	18.8%	3
51% to 75%	6.3%	1
Greater than 75%	6.3%	1
	answered question	16

Do you use the CPM schedules to justify/quantify the amount of time for a time extension?

Answer Options	Response Percent	Response Count
Yes	93.8%	15
No	6.3%	1
	answered question	16

Other than resolving time issues, current project status, and cash flow projections what are you using the CPM schedules for in your district/county?

Answers

Manpower workloads and CEI projections if info is accurate.
Claims analysis and documentation.
Overview of anticipated project completion dates for media.
Looking at seasonal restrictions, and staging work during critical times.

answered question 9

What types of construction projects benefit the most by requiring a CPM schedule to track and project activities?

Answers

Projects with construction duration greater than 1 year.
Only on projects that the contractor will use them on.

Complex/high risk projects (Interstate, multiple stage, new location, urban complex widening).
Larger $10 Million contract value or greater.
Projects with A+B, D/B, minimum CPS score, large ADT roads of 10K or greater.
Projects with numerous concurrent activities.

answered question 17

SCDOT - Critical Path Scheduling Specification
(Director of Construction / District Construction Engineers)

What types of construction projects have minimal risk and do not need a CPM schedule on them?

Answers

Short construction duration projects.
Low total contract / low risk projects.
Low traffic impact less than 10K ADT.
Projects with minimal utility conflicts.
Resurfacing, simple bridge replacement, LPA, ITMS, landscaping, minor intersection).

On-call (rpms, guardrail, sidewalk, ADA ramp, pavement marking, rumble strip, FDP, sign, signal).

answered question 16

Appendix D

SCDOT - Critical Path Scheduling Specification (Resident Construction Engineer)

What SCDOT district do you mostly work in?

Answer Options	Response Percent	Response Count
District 1	19.6%	9
District 2	13.0%	6
District 3	17.4%	8
District 4	10.9%	5
District 5	15.2%	7
District 6	15.2%	7
District 7	8.7%	4
Statewide	0.0%	0
	answered question	46

If we did not have a contractual requirement, what percentage of contractors do you feel would still perform a CPM schedule for their own benefit?

Answer Options	Response Percent	Response Count
None	18.2%	8
1% to 5%	13.6%	6
6% to 10%	18.2%	8
11% to 25%	27.3%	12
25% to 50%	13.6%	6
Greater than 50%	9.1%	4
	answered question	44

Do you enforce the CPM schedule specifications (withhold payments for no submission, discuss late submittals with contractor, and recommend preliminary delinquency)?

Answer Options	Response Percent	Response Count
Yes	100.0%	46
No	0.0%	0
	answered question	46

SCDOT - Critical Path Scheduling Specification (Resident Construction Engineer)

Do you feel the contractors CPM schedules are more beneficial than a traditional 4-week schedule updated every 2-week?

Answer Options	Response Percent	Response Count
Yes	37.2%	16
No	62.8%	27
	answered question	43

How much time do you spend on average to review CPM baselines prior to construction?

Answer Options	Response Percent	Response Count
None	10.9%	5
Less than 1 hour	60.9%	28
1 to 2 hours	19.6%	9
Greater than 2 hours	8.7%	4
Unknown	0.0%	0
	answered question	46

How much time do you spend on average to review monthly CPM updates for accuracy each month?

Answer Options	Response Percent	Response Count
None	15.6%	7
Less than 1 hour	71.1%	32
1 to 2 hours	11.1%	5
Greater than 2 hours	2.2%	1
Unknown	0.0%	0
	answered question	45

Who typically reviews the contractors monthly CPM updates in addition to the district scheduler?

Answer Options	Response Percent	Response Count
Resident Construction Engineer	30.4%	14
Assistant Resident Construction Engineer	15.2%	7
Project Manager	41.3%	19
Office Administrator	0.0%	0
Nobody	13.0%	6
	answered question	46

SCDOT - Critical Path Scheduling Specification (Resident Construction Engineer)

Do you feel that the current specification CPM schedule is a benefit to the finance department?

Answer Options	Response Percent	Response Count
Yes	70.7%	29
No	29.3%	12
	answered question	41

Do you feel that the current specification CPM schedule is a benefit to the RCE & field staff?

Answer Options	Response Percent	Response Count
Yes	53.3%	24
No	46.7%	21
	answered question	45

Do you feel that the current specification CPM schedule is a benefit to the contractor's field personnel?

Answer Options	Response Percent	Response Count
Yes	9.8%	4
No	90.2%	37
	answered question	41

Would a universal estimate date at the end of the month state-wide be a problem for you?

Answer Options	Response Percent	Response Count
Yes	2.2%	1
No	97.8%	45
	answered question	46

What percentage of CPM schedules indicate they are behind schedule for only one month, but finish on time?

Answer Options	Response Percent	Response Count
All	0.0%	0
75% to 99%	41.4%	12
50% to 74%	34.5%	10
25% to 49%	10.3%	3
Less than 25%	13.8%	4
	answered question	29

SCDOT - Critical Path Scheduling Specification (Resident Construction Engineer)

What percentages of CPM schedules indicate they are behind schedule for more than 3 consecutive months, but the schedule is adjusted and they finish on time?

Answer Options	Response Percent	Response Count
All	0.0%	0
75% to 99%	18.5%	5
50% to 74%	18.5%	5
25% to 49%	33.3%	9
Less than 25%	29.6%	8
answered question		27

Without the use of a CPM schedule how far out do you feel that you can accurately determine something has to change (additional manpower, production, man hours worked, etc.) or the schedule will never recover?

Answer Options	Response Percent	Response Count
One month	37.5%	9
Two months	29.2%	7
Three months	16.7%	4
Four months	16.7%	4
answered question		24

How far ahead do you feel that the monthly update CPM schedules are accurate enough to forecast monthly payout state wide?

Answer Options	Response Percent	Response Count
Not accurate to forecast at all	19.0%	8
1 month	33.3%	14
2 months	40.5%	17
3 months	7.1%	3
answered question		42

SCDOT - Critical Path Scheduling Specification (Resident Construction Engineer)

How can we improve the accuracy of CPM schedules submitted by the contractor/consultant?

Answers

Update schedules more frequently (weekly).
Have SCDOT do updates based on monthly project meetings.
Better communication between scheduler and field personnel.
Hold contractors more accountable and issue monthly CPM update penalties.
Simplify everything, and utilize in the field.
Train and certify schedulers.
Link contractor pay to contractors schedules.
Develop a PWL pay specification for monthly schedule payout.
It is a contractor issue; he must buy in and use the schedule.
Consistent enforcement of a milestone completion schedule tie to a payout.
Move to preliminary delinquency quicker and copy bonding company.
Omit CPM requirement on low cost/less risk projects less than $5Million/$10 Million.
Evaluate/score contractors scheduling ability and make it a requirement when bidding.
Improve environment/relationship between schedulers and contractors.
Field logic and CPM logic must be the same, need only one schedule to work from.
Incentive/Disincentive for cash flow on schedules.

answered questions 31

What percentage of contractors do you feel actually follow their monthly schedules in the field?

Answer Options	Response Percent	Response Count
None 0%	8.9%	4
1 % to 10%	35.6%	16
10% to 25%	24.4%	11
26% to 50%	24.4%	11
51% to 75%	6.7%	3
Greater than 75%	0.0%	0
answered question		45

What percentage of change orders requesting a time extension, have been evaluated/reviewed by the district scheduler prior to the RCE submitting a change order?

Answer Options	Response Percent	Response Count
100% All	30.2%	13
99% to 75%	20.9%	9
74% to 50%	11.6%	5
49% to 25%	7.0%	3
24% to 1%	9.3%	4
0% None of them	20.9%	9
answered question		43

SCDOT - Critical Path Scheduling Specification (Resident Construction Engineer)

Do you use the CPM schedules to justify/quantify the amount of time for a time extension?

Answer Options	Response Percent	Response Count
Yes	65.2%	30
No	34.8%	16
answered question		46

Other than resolving time issues, current project status, and cash flow projections what are you using the CPM schedules for in your district/county?

Answers
Assign projects and determine manpower projections for inspectors and CEI.
Satisfy QMT requirement.
Helps resolve claims issues regarding time.
Identify critical work items to monitor during construction.
Determine rough work start and project completion dates.
answered question 20

What types of construction projects benefit the most by requiring a CPM schedule to track and project activities?

Answers
Large / complex / high risk projects (Greater than $750K, $5 Million)
Long duration projects (6 month, 8 month, 9 month, greater than 1 season)
Design Build, A+B, Multi-stage, multiple concurrent activities.
Bridge, new location and Interstate projects with multiple stages.
Multicounty resurfacing (greater than 10 roads).
Projects with numerous subcontractors.
Projects with numerous utility conflicts.
Widening projects, cement modified base, and projects with seasonal restrictions.
answered question 44

What types of construction projects have minimal risk and do not need a CPM schedule on them?

Answers
On-call Maintenance projects (striping, thermo, sidewalk, ramps, guardrail, RPM, signs).
Specialty contractor projects (ITS, micro surfacing, signal, landscaping).
Small projects with limited scope (less than $5 Million).
Short duration projects (2 months, 3 months, 6 months, 1 year).
answered question 45

Appendix E

SCDOT - Critical Path Scheduling Specification (District CPM Schedulers)

What SCDOT district do you mostly work in?

Answer Options	Response Percent	Response Count
District 1	14.3%	1
District 2	14.3%	1
District 3	14.3%	1
District 4	14.3%	1
District 5	14.3%	1
District 6	14.3%	1
District 7	14.3%	1
Statewide	0.0%	0
	answered question	7

On average, how many CPM schedules baselines do you review each month?

Answer Options	Response Percent	Response Count
0 to 2	0.0%	0
3 to 5	85.7%	6
6 to 8	14.3%	1
More than 8	0.0%	0
	answered question	7

On average, how many non-CPM baselines do you create each month?

Answer Options	Response Percent	Response Count
0 to 2	42.9%	3
3 to 5	42.9%	3
6 to 8	14.3%	1
More than 8	0.0%	0
	answered question	7

How much time does an average CPM schedule baseline take to review?

Answer Options	Response Percent	Response Count
1 hour or less	14.3%	1
1 to 4 hours	28.6%	2
4 to 8 hours	42.9%	3
1 day or greater	14.3%	1
	answered question	7

How much time does an average non-CPM schedule baseline take to create?

Answer Options	Response Percent	Response Count
1 hour or less	28.6%	2
1 to 2 hours	57.1%	4
2 to 3 hours	14.3%	1
Greater than 3 hours	0.0%	0
	answered question	7

What percentages of CPM baselines are reviewed/acceptable prior to a precon?

Answer Options	Response Percent	Response Count
90% to 100%	42.9%	3
75% to 89%	42.9%	3
50% to 74%	0.0%	0
25% to 49%	0.0%	0
0% to 24%	14.3%	1
	answered question	7

What percentages of CPM schedule baselines need to be resubmitted?

Answer Options	Response Percent	Response Count
90% to 100%	14.3%	1
75% to 89%	0.0%	0
50% to 74%	14.3%	1
25% to 49%	28.6%	2
0% to 24%	42.9%	3
	answered question	7

Is there a pattern of the same contractors/consultants who need to make multiple baseline submittals?

Answer Options	Response Percent	Response Count
Yes	42.9%	3
No	57.1%	4
	answered question	7

On average, how many CPM monthly updates do you review each month?

Answer Options	Response Percent	Response Count
0 to 20	14.3%	1
20 to 30	57.1%	4
30 to 40	28.6%	2
Greater than 40	0.0%	0
	answered question	7

On average, how many non-CPM updates do you create each month?

Answer Options	Response Percent	Response Count
0 to 5	28.6%	2
5 to 10	28.6%	2
10 to 15	42.9%	3
Greater than 15	0.0%	0
	answered question	7

How much time does an average CPM schedule update take to review?

Answer Options	Response Percent	Response Count
[redacted] hour or less	14.3%	1
[redacted] to 4 hours	57.1%	4
4 to 8 hours	28.6%	2
1 day or greater	0.0%	0
	answered question	7

How much time does an average non-CPM schedule update take to create?

Answer Options	Response Percent	Response Count
30 minutes or less	14.3%	1
30 to 60 minutes	42.9%	3
1 to 2 hours	42.9%	3
Greater than 2 hours	0.0%	0
	answered question	7

What percentage of CPM updates are received prior to the monthly due date?

Answer Options	Response Percent	Response Count
90% to 100%	14.3%	1
75% to 89%	28.6%	2
50% to 74%	28.6%	2
less than 50%	28.6%	2
	answered question	7

Is there a pattern of the same contractors/consultants who are late with their monthly update submittals?

Answer Options	Response Percent	Response Count
Yes	85.7%	6
No	14.3%	1
	answered question	7

What percentage of CPM schedule updates need to be resubmitted?

Answer Options	Response Percent	Response Count
More than 50%	0.0%	0
49 to 40%	0.0%	0
39 to 30%	14.3%	1
29 to 20%	0.0%	0
19 to 10%	28.6%	2
Less than 10%	57.1%	4
	answered question	7

Is there a pattern of the same contractors/consultants who need to make revisions to monthly updates?

Answer Options	Response Percent	Response Count
Yes	42.9%	3
No	57.1%	4
	answered question	7

What percentages of CPM schedules indicate they are behind schedule for only one month, but finish on time?

Answer Options	Response Percent	Response Count
All	0.0%	0
75% to 99%	50.0%	3
50% to 74%	50.0%	3
25% to 49%	0.0%	0
Less than 25%	0.0%	0
	answered question	6

What percentages of CPM schedules indicate they are behind schedule for more than 3 consecutive months, but the schedule is adjusted and they finish on time?

Answer Options	Response Percent	Response Count
All	0.0%	0
75% to 99%	16.7%	1
50% to 74%	16.7%	1
25% to 49%	16.7%	1
Less than 25%	50.0%	3
	answered question	6

Without the use of a CPM schedule how far out do you feel that you can accurately determine something has to change (additional manpower, production, man hours worked, etc.) or the schedule will never recover?

Answer Options	Response Percent	Response Count
One month	0.0%	0
Two months	14.3%	1
Three months	28.6%	2
Four months	14.3%	1
Unknown	42.9%	3
	answered question	7

What percentage of change orders requesting a time extension, have been evaluated/reviewed by the district scheduler prior to the RCE submitting a change order?

Answer Options	Response Percent	Response Count
100% All	28.6%	2
99% to 75%	14.3%	1
74% to 50%	28.6%	2
49% to 25%	28.6%	2
24% to 1%	0.0%	0
0% None of them	0.0%	0
	answered question	7

Other than reviewing/creating schedules, on average how much time monthly do you perform other duties?

Answer Options	Response Percent	Response Count
None	42.9%	3
1 to 10 hours	14.3%	1
11 to 20 hours	14.3%	1
21 to 30 hours	0.0%	0
Greater than 30 hours	28.6%	2
	answered question	7

How far ahead do you feel that the monthly update CPM schedules are accurate enough to forecast monthly payout state wide?

Answer Options	Response Percent	Response Count
Not accurate to forecast at all	28.6%	2
1 month	14.3%	1
2 months	0.0%	0
3 months	57.1%	4
	answered question	7

How can we improve the accuracy of CPM schedules submitted by the contractor/consultant?

Answers

Cut down on the less critical schedules to spend more time on complex/high risk ones.
Submit schedules when due, report scheduling performance on contractor evaluations.
Consider incentive/disincentive for contractor schedule performance.
Need to improve scheduling buy-in by all parties involved to benefit all parties.
Hold contractor accountable and have consequences for poor data/schedules.
Enforce consequences more and copy bonding companies when not performing.

answered question 7

What percentage of contractors do you feel actually follow their monthly schedules in the field?

Answer Options	Response Percent	Response Count
None 0%	0.0%	0
1 % to 10%	0.0%	0
10% to 25%	28.6%	2
26% to 50%	42.9%	3
51% to 75%	14.3%	1
Greater than 75%	14.3%	1
	answered question	7

If we did not have a contractual requirement, what percentage of contractors do you feel would still perform a CPM schedule for their own benefit?

Answer Options	Response Percent	Response Count
None	0.0%	0
1 to 5%	14.3%	1
6 to 10%	0.0%	0
11 to 25%	28.6%	2
25 to 50%	14.3%	1
Greater than 50%	42.9%	3
	answered question	7

SCDOT - Critical Path Scheduling Specification (District CPM Schedulers)

Do you feel that the current specification CPM schedule is a benefit to the finance department?

Answer Options	Response Percent	Response Count
Yes	50.0%	3
No	50.0%	3
answered question		6

Do you feel that the current specification CPM schedule is a benefit to the RCE & field staff?

Answer Options	Response Percent	Response Count
Yes	85.7%	6
No	14.3%	1
answered question		7

Do you feel that the current specification CPM schedule is a benefit to the contractor's field personnel?

Answer Options	Response Percent	Response Count
Yes	50.0%	3
No	50.0%	3
answered question		6

Would a universal estimate date at the end of the month state-wide be a problem for you?

Answer Options	Response Percent	Response Count
Yes	0.0%	0
No	100.0%	7
answered question		7

Other than resolving time issues, current project status, and cash flow projections what are you using the CPM schedules for in your district/county?

Answers

Documentation for potential claims for delay and hold contractors accountable.
Manpower projections, and forecasting inspection and CEI needs for the season.
Project distribution of work for RCE assignment.
Communication tool for politicians, officials, and the public.
Coordinate work activities with others and schedule around traffic sensitive areas/times.
Identifies critical milestones / activities and identifies problems when they occur.

answered question 7

What types of construction projects benefit the most by requiring a CPM schedule to track and project activities?

Answers

Complex projects (high traffic, high profile, high public impact, Interstate, large widening).
Design/Build, new location or A+B projects.
Projects with multiple concurrent activities or tight durations.
Projects with complex utility relocation and impacts to project.
Projects with numerous roads or multiple locations of activity.
Projects with high chance of unknowns for claims/delay.

answered question 7

What types of construction projects have minimal risk and do not need a CPM schedule on them?

Answers

On-call projects (guardrail, sidewalk, enhancement, chip seal, RPMs, signal, ramps).
Small resurfacing, re-stripping, bridge paint, LPA, strip map.

answered question 7

Appendix F

Are construction estimates received by accounting as anticipated?

Answer Options	Response Percent	Response Count
Yes	50.0%	1
No	50.0%	1
answered question		2

Do you rely on scheduled monthly construction estimate payouts to forecast demands on cash flow?

Answer Options	Response Percent	Response Count
Yes	100.0%	2
No	0.0%	0
answered question		2

What is an acceptable range of deviation from scheduled monthly construction estimate payout for a 1 month out forecast?

Answer Options	Response Percent	Response Count
0 to 5%	0.0%	0
5 to 10%	100.0%	2
10 to 15%	0.0%	0
15 to 20%	0.0%	0
20 to 25%	0.0%	0
25 to 30%	0.0%	0
answered question		2

Are we currently meeting your expectations for 1 month out forecast?

Answer Options	Response Percent	Response Count
Yes	50.0%	1
No	50.0%	1
answered question		2

What is an acceptable range of deviation from scheduled monthly construction estimate payout for a 3 month out forecast?

Answer Options	Response Percent	Response Count
0 to 5%	0.0%	0
5 to 10%	50.0%	1
10 to 15%	0.0%	0
15 to 20%	50.0%	1
20 to 25%	0.0%	0
25 to 30%	0.0%	0
	answered question	2

Are we currently meeting your expectations for 3 month out forecast?

Answer Options	Response Percent	Response Count
Yes	50.0%	1
No	50.0%	1
	answered question	2

What is an acceptable range of deviation from scheduled monthly construction estimate payout for a 6 month out forecast?

Answer Options	Response Percent	Response Count
0 to 5%	0.0%	0
5 to 10%	50.0%	1
10 to 15%	0.0%	0
15 to 20%	50.0%	1
20 to 25%	0.0%	0
25 to 30%	0.0%	0
	answered question	2

Are we currently meeting your expectations for 6 month out forecast?

Answer Options	Response Percent	Response Count
Yes	0.0%	0
No	100.0%	2
	answered question	2

SCDOT - Critical Path Scheduling Specification (SCDOT - Finance)

How far out do you look using scheduled monthly construction estimates?

Answer Options	Response Percent	Response Count
0 to 6 months	0.0%	0
6 to 12 months	0.0%	0
12 to 18 months	50.0%	1
18 to 24 months	50.0%	1
	answered question	2

What is an acceptable range of deviation from scheduled monthly construction estimate payout for your farthest out forecast?

Answer Options	Response Percent	Response Count
0 to 5%	0.0%	0
5 to 10%	50.0%	1
10 to 15%	0.0%	0
15 to 20%	50.0%	1
20 to 25%	0.0%	0
25 to 30%	0.0%	0
	answered question	2

Are we currently meeting your expectations for the furthest out forecast?

Answer Options	Response Percent	Response Count
Yes	50.0%	1
No	50.0%	1
	answered question	2

Does the current accuracy of forecasted construction dollars each month have a value to the finance department?

Answer Options	Response Percent	Response Count
Yes	100.0%	2
No	0.0%	0
	answered question	2

How much do you feel is reasonable to expend to provide a three month financial projection that is accurate within +/- 30%?

Answer Options	Response Percent	Response Count
$0 to $100,000	50.0%	1
$100,000 to $200,000	0.0%	0
$200,000 to $300,000	0.0%	0
$300,000 to $400,000	0.0%	0
$400,000 to $500,000	50.0%	1
Other (please specify)		0
	answered question	2

How much do you feel is reasonable to expend to provide a three month financial projection that is accurate within +/- 20%?

Answer Options	Response Percent	Response Count
$0 to $100,000	50.0%	1
$100,000 to $200,000	0.0%	0
$200,000 to $300,000	0.0%	0
$300,000 to $400,000	50.0%	1
$400,000 to $500,000	0.0%	0
Other (please specify)		0
	answered question	2

How much do you feel is reasonable to expend to provide a three month financial projection that is accurate within +/- 10%?

Answer Options	Response Percent	Response Count
$0 to $100,000	0.0%	0
$100,000 to $200,000	50.0%	1
$200,000 to $300,000	50.0%	1
$300,000 to $400,000	0.0%	0
$400,000 to $500,000	0.0%	0
Other (please specify)		0
	answered question	2

Is there a particular day of the month each month you need scheduled monthly construction data compiled?

Answers
No, as long as it is the same day each month.
answered question 1

SCDOT - Critical Path Scheduling Specification (SCDOT - Finance)

Would a universal estimate generation date at the end of the month state-wide be a problem for you?

Answer Options	Response Percent	Response Count
Yes	0.0%	0
No	100.0%	2
answered question		2

Appendix G

What is the name of your Company (optional)?

answered question 18

Do you create/update the CPM schedules in house or use a scheduling consultant?

Answer Options	Response Percent	Response Count
In house CPM baseline / monthly updates.	58.8%	20
Consultant CPM baseline / monthly updates.	41.2%	14
answered question		34

If the SCDOT did not have a contractual requirement, what percentage of your SCDOT projects do you feel you would still perform a CPM schedule on for your own benefit?

Answer Options	Response Percent	Response Count
100% - All	25.7%	9
75% to 99%	14.3%	5
50% to 74%	14.3%	5
25% to 49%	14.3%	5
1% to 24%	8.6%	3
0% - None	22.9%	8
answered question		35

Would additional scheduling training by the SCDOT be of benefit to you if the CPM specification remained unchanged?

Answer Options	Response Percent	Response Count
Yes	54.5%	18
No	45.5%	15
answered question		33

Besides being required to submit a CPM schedule, what is your top issue with the current specification?

Answer Options	Response Percent	Response Count
1. Too much info required for limited scope projects.	18.5%	10
2. Schedule for SCDOT benefit only, not used.	18.5%	10
3. Other (Only one reviewer responded with this answer)	13.0%	7
4. Reviewer preference, inconsistent reviews.	11.1%	6
5. Too many unknowns beyond schedulers control.	11.1%	6
6. Need estimate to provide accurate schedule.	7.4%	4
7. 30 max limit for activities.	7.4%	4
8. Need more training for users/reviewers.	5.6%	3
9. Contractor uses a different schedule than CPM.	3.7%	2
10. Cost Loading by project bid items.	3.7%	2
answered question		54

What states other than SC do you work in that require a CPM schedule?

Answer Options	Response Percent	Response Count
None	51.2%	22
Florida	9.3%	4
North Carolina	9.3%	4
Virginia	9.3%	4
Georgia	4.7%	2
Connecticut	2.3%	1
West Virginia	2.3%	1
California	2.3%	1
Texas	2.3%	1
Maryland	2.3%	1
Oregon	2.3%	1
Tennessee	2.3%	1
Louisiana	2.3%	1
answered question		43

If we did not have a contractual requirement for use of Primavera, what is your preferred scheduling software?

Answer Options	Response Percent	Response Count
Primavera	54.2%	13
Microsoft	41.7%	10
Excel	4.2%	1
answered question		24

How do you view CPM schedules?

Answer Options	Response Percent	Response Count
Valuable resource for the contractor should utilize on all projects.	42.4%	14
Valuable resource for the contractor but only used on large high risk projects.	21.2%	7
Minimal value to the contractor on most SCDOT construction projects.	12.1%	4
Something to meet a contract obligation.	24.2%	8
answered question		33

Do you use the CPM schedules to forecast man-hours and monthly expenditures?

Answer Options	Response Percent	Response Count
Yes	24.2%	8
No	75.8%	25
answered question		33

Do you feel that the current specification CPM schedules are more beneficial than a traditional 4-week schedule updated every 2-week?

Answer Options	Response Percent	Response Count
Yes	46.9%	15
No	53.1%	17
answered question		32

How much time do you spend on average to generate a CPM baseline schedule prior to bidding?

Answer Options	Response Percent	Response Count
None	42.4%	14
1 day or less	21.2%	7
1 to 3 days	27.3%	9
3 to 5 days	3.0%	1
Greater than 5 days	6.1%	2
answered question		33

How much time do you spend on average to generate a CPM baseline schedule prior to award?

Answer Options	Response Percent	Response Count
None	51.5%	17
1 day or less	24.2%	8
1 to 3 days	3.0%	1
3 to 5 days	6.1%	2
Greater than 5 days	15.2%	5
	answered question	33

How much time do you spend on average to generate a CPM baseline prior to the precon meeting?

Answer Options	Response Percent	Response Count
None	9.1%	3
1 day or less	6.1%	2
1 to 3 days	39.4%	13
3 to 5 days	27.3%	9
Greater than 5 days	18.2%	6
	answered question	33

How much time do you spend on average to generate monthly CPM updates each month?

Answer Options	Response Percent	Response Count
None	6.1%	2
1 hour or less	3.0%	1
1 to 4 hours	27.3%	9
4 to 8 hours	45.5%	15
Greater than 8 hours	18.2%	6
	answered question	33

How do you typically get field information for monthly CPM updates?

Answer Options	Response Percent	Response Count
Site visits	20.8%	10
Superintendent updates	22.9%	11
Project Manager updates	31.3%	15
Review last estimate and project paperwork	25.0%	12
	answered question	48

Do you feel that your time spent on the CPM baseline & monthly updates is a benefit to your company?

Answer Options	Response Percent	Response Count
Yes	60.6%	20
No	39.4%	13
	answered question	33

Do you feel that the current specification CPM schedule is a benefit to your field personnel?

Answer Options	Response Percent	Response Count
Yes	27.3%	9
No	72.7%	24
	answered question	33

If the department went to a universal estimate date ending at the end of each month statewide, would your scheduler be able to provide all updates by the 15th of the following month?

Answer Options	Response Percent	Response Count
Yes	81.8%	27
No	18.2%	6
	answered question	33

What percentages of CPM schedules indicate they are behind schedule for only one month, but finish on time?

Answer Options	Response Percent	Response Count
All	6.3%	2
99 to 75%	40.6%	13
74 to 50%	18.8%	6
50 to 1%	31.3%	10
None	3.1%	1
	answered question	32

What percentages of CPM schedules indicate they are behind schedule for more than 3 consecutive months, but the schedule is adjusted and they finish on time?

Answer Options	Response Percent	Response Count
All	3.2%	1
99 to 75%	19.4%	6
74 to 50%	29.0%	9
50 to 1%	41.9%	13
None	6.5%	2
	answered question	31

Without the use of a CPM schedule how far out do you feel that you can accurately determine something has to change (additional manpower, production, man hours worked, etc.) or the schedule will never recover?

Answer Options	Response Percent	Response Count
One month	27.3%	9
Two months	42.4%	14
Three months	15.2%	5
Four months	15.2%	5
	answered question	33

How can we improve the accuracy of CPM schedules submitted by the contractor/consultant?

Answers
More training (require certification)
Submit estimates on time.
More communication between schedulers.
Only require schedules on complex projects.
Better coordination with utility companies.
Focus on 90 day look ahead.
Remove cost loading based on bid items
Allow preferential logic FF lags and zero float to delivery activities.
Consequences for contractor for missing milestone date.
Baseline schedule buy in by all parties.
Focus on managing people, not software.
Need to change old mindset and see benefit of schedules.
Utilize less complicated software.
Minimize risk/unknowns for contractor.
answered question 21

Do you use the CPM schedules to justify/quantify the amount of time for a time extension?

Answer Options	Response Percent	Response Count
Yes	66.7%	22
No	33.3%	11
	answered question	33

Do you feel that the monthly update CPM schedules are accurate enough to forecast monthly payout state wide - Three months out?

Answer Options	Response Percent	Response Count
Yes	45.5%	15
No	54.5%	18
	answered question	33

What percentage of contractors do you feel actually follow their monthly schedules in the field?

Answer Options	Response Percent	Response Count
None	3.2%	1
Less than 10%	16.1%	5
10% to 25%	19.4%	6
26% to 50%	29.0%	9
51% to 75%	29.0%	9
Greater than 75%	3.2%	1
	answered question	31

What types of construction projects benefit the most by requiring a CPM schedule to track and project activities?

Answers

High risk projects (Bridges, Interstate widening, D/B, extensive storm drainage)

High risk projects with large utility coordination, high profile, time sensitive projects, new location.

Projects with 8-10 subcontractors to coordinate activities with, quantity intensive projects.
Projects with longer construction duration greater than one season, or multiple phases.
Projects greater than $5 Million ($10 Million).
Large projects which have 7 day work activity, or time sensitive deadlines.

answered question 31

What types of construction projects have minimal risk and do not need a CPM schedule on them?

Answers

Low Risk Projects (mill/fill, FDP, on-call, landscaping, simple bridge replacement, signal, paint, RPM).
Projects with minimal subcontractors.
Projects with short duration (3 month, 6 month, 1 year).
Resurfacing contracts (Less than $1.5 Million, $2 Million, $10 Million)

answered question 30

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